Two new members of the Elcanidae (Insecta, Orthoptera) from mid-Cretaceous amber

Ole-Kristian Odin Schall[1], Ulrich Kotthoff[2], Martin Husemann[3]

1 Leibniz Institute for the Analysis of Biodiversity Change (LIB), Centre for Taxonomy and Morphology (ztm), Hamburg, 20146, Germany.
2 Leibniz Institute for the Analysis of Biodiversity Change (LIB), Centre for Biodiversity Monitoring and Conservation Science (zbm), Hamburg, 20146, Germany.
3 State Museum for Natural History Karlsruhe (SMNK), Karlsruhe, Baden-Württemberg, 76133, Germany.

Corresponding author: Ole-Kristian Odin Schall (ole_schall@web.de)

Academic editor: Klaus-Gerhard Heller | Received 1 November 2024 | Accepted 15 April 2025 | Published 22 January 2026

https://zoobank.org/4E733344-FA9D-41D3-B935-B998E59696B7

Citation: Schall O-KO, Kotthoff U, Husemann M (2026) Two new members of the Elcanidae (Insecta, Orthoptera) from mid-Cretaceous amber. Journal of Orthoptera Research 35(1): 63–68. https://doi.org/10.3897/jor.35.140770

Abstract

A new species of the Burmese amber genus *Pseudopanorpidium* Schall, Willmott, Kotthoff & Husemann, 2025 is described as *P. inversa* **sp. nov.** Its name is derived from the inverse color scheme of the wings: the dark wing spots and wing margin usually found on the forewings of elcanids are located on the hindwings in the new species. Additionally, a new member of the Archelcaninae Gorochov, Jarzembowski & Coram, 2006 is described from mid-Cretaceous Burmese amber. *Thagyaminana atawedeia* **gen. et sp. nov.** is the third member of the subfamily to be reported from this origin and the first among them to show three branches of M between CuA + CuPaα and the stem of RP.

Keywords

fossil, hindwing, taxonomy

Introduction

Elcanidae are an extinct family of Orthoptera Olivier, 1789 with a mostly Mesozoic fossil record and singular putative occurrences from the Permian and Paleocene epochs, respectively (Schubnel et al. 2020, Tillyard 1918). There are two subfamilies, Elcaninae Handlirsch, 1906 and Archelcaninae Gorochov, Jarzembowski & Coram, 2006, which can be differentiated by the presence or absence of a distal fusion of the forewing veins 1A, CuPb, and CuPaβ (a fusion indicates an Elcaninae) (Gorochov et al. 2006).

Several genera of this family have been reported from Laurasia, while the Gondwanan continents have yielded less diversity (Zhou et al. 2024). In recent years, numerous important findings of Elcanidae have been made in amber from Myanmar (Burmese amber) (e.g. Poinar et al. 2007, Heads et al. 2018, Gu et al. 2020). This ecosystem is of uncertain paleogeographic history (Westerweel et al. 2019), and possible faunal affinities with Laurasia and Gondwana have been suggested (Bolotov et al. 2022, Nel and Jouault 2022). Most recent findings point toward a Gondwanan affinity of the Orthopteran fauna of Burmese amber (Willmott et al. 2025).

Since the publication of Poinar et al. (2007), Burmese amber has proven an invaluable resource for understanding Elcanidae diversity and ecology (Kočárek 2020, Willmott et al. 2025). Many species of both subfamilies from this origin have been unearthed, greatly adding to our knowledge of the family's ovipositor, pronotum, metathoracic leg, and spur morphology (Heads et al., 2018; Hu and He 2023). These new characters have begun to enable a wider approach in deciphering Elcanidae phylogeny, which, before the description of Burmese amber Elcanidae, relied heavily on wing venation (Gorochov et al. 2006).

In this study, we describe two new taxa of Elcanidae from Burmese amber. These species add to the diversity of the family known from the tropical Cretaceous forest ecosystem represented by the amber.

Materials and methods

The taxonomy in this study follows the Orthoptera Species File (Cigliano et al. 2024; https://orthoptera.speciesfile.org/). Wing venation nomenclature follows Béthoux and Nel (2002) with the following abbreviations: CP, posterior costa; ScA/ScP, anterior/posterior subcosta; R, radius; RA/RP, anterior/posterior radius; MA/MP, anterior/posterior media; CuA/CuP, anterior/posterior cubitus; CuPa, anterior branch of CuP; CuPaα, anterior branch of CuPa; CuPaβ, posterior branch of CuPa; CuPb, posterior branch of CuP; 1A, anterior anal vein.

Copyright *Ole-Kristian Odin Schall et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

The amber pieces used in this study are housed in the collection of the Leibniz Institute for the Analysis of Biodiversity Change (LIB) Hamburg (GPIH07021 and GPIH07022). They originate from Myanmar, but the exact location of their discovery is unclear—it was either at a mining site near Tanai village or Hkamti village. The age of the two amber sites differs by ca. 10 My. Amber from Tanai is estimated to be 98.79 ± 0.62 My old (Shi et al. 2012), while amber from Hkamti is ca. 110 My old (Xing and Qiu 2020). Amber of Burmese origin is unfortunately burdened by ethical conflict regarding the conditions of the mining workers as well the potential for the purchasing of fossils for scientific purposes fueling the Myanmar civil war (Peretti 2020, Peretti 2021, Dunne et al. 2022). The interested reader is invited to consider Peretti (2021), which highlights the risks of a ban of publications involving Burmese amber for the local communities in Myanmar.

Imaging of the specimens was conducted using a DUN. Inc. stacking system with a Canon EOS 5Dsr camera with a 65 mm lens and a magnification of 1× and 1.5×. Individual pictures were taken using VD Passport and the Capture One program (Capture One A/S, Denmark) and stacked with Zerene Stacker (Zerene Systems LLC, Washington, USA). They were edited with the Photoshop CS6 Extended application by Adobe Inc. (USA; https://www.adobe.com). Further modifications (e.g., scale-bars) and the creation of image collections were done in Inkscape (v. 1.4) (the Inkscape Team, 2025 https://inkscape.org/). Drawings were created in GIMP (v. 2.10.30) (the GIMP Team, https://www.gimp.org/ 2024) by direct-layer copying.

Systematic paleontology

Order: Orthoptera Olivier, 1789
Superfamily: Elcanoidea Handlirsch, 1906
Family: Elcanidae Handlirsch, 1906
Subfamily: Elcaninae Handlirsch, 1906

Genus: *Pseudopanorpidium* **Schall, Willmott, Kotthoff & Husemann, 2025**

Type species.—*P. maculosum* (Zhou, Xu, Jarzembowski & Xiao, 2022).

Pseudopanorpidium inversa **sp. nov.**
https://zoobank.org/A7387223-3141-4607-B6B4-01C1D466995C
Figs 1, 2

Etymology.—"Inversa" is derived from Latin "invertere," literally meaning "to invert" or "to turn around," referring to the inverted color scheme of this species' wings.

Locality and horizon.—The specimen is included in amber found in Hkamti, Sagaing Division, Myanmar and Tanai, Kachin State Burma, Myanmar, two nearby amber mining locations. The amber from Hkamti is ca. 110 My, and the amber from Tanai is ca. 99 My old.

Holotype.—The male holotype specimen is deposited in the collection of the LIB, Hamburg, collection number GPIH07021.

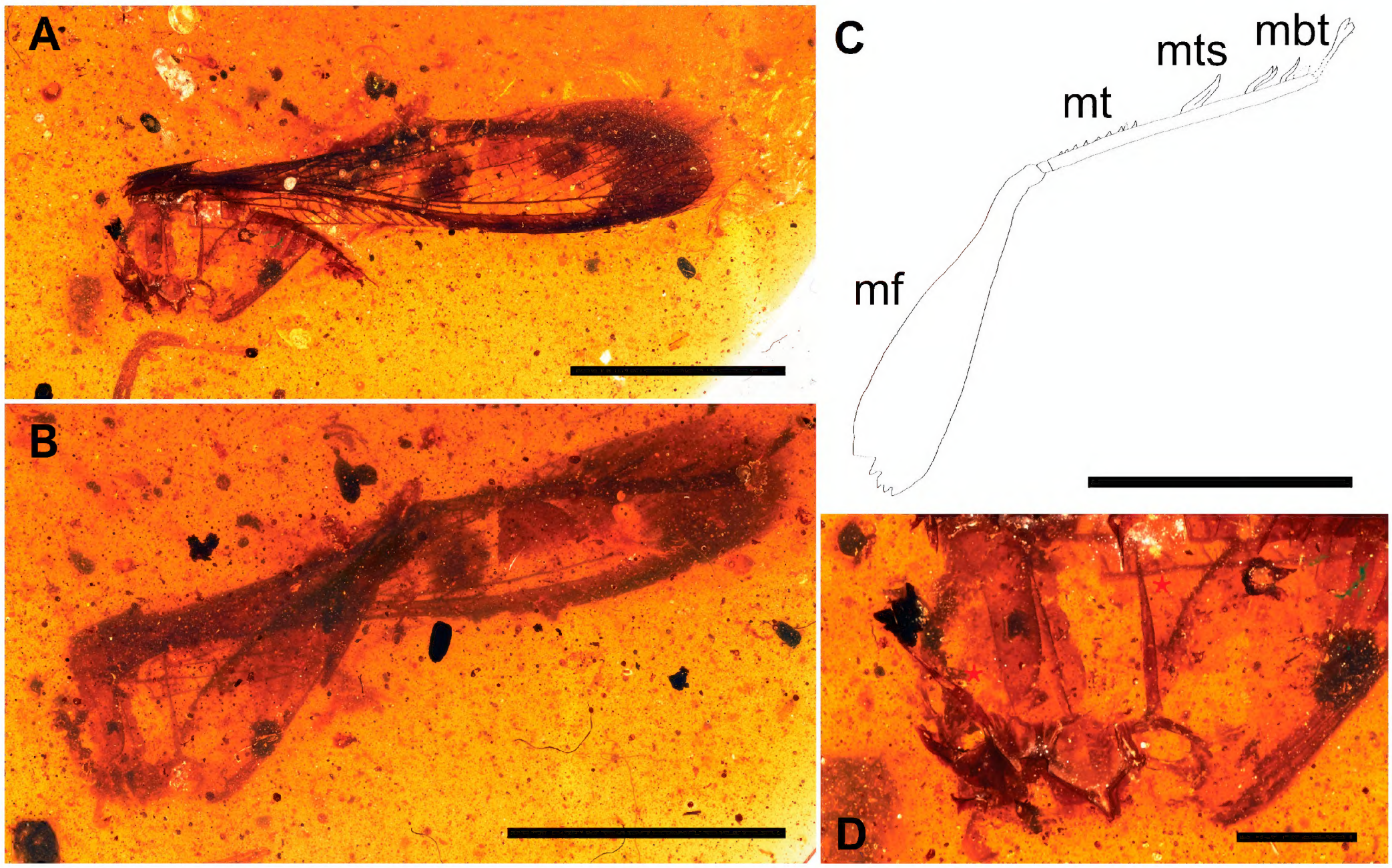

Fig. 1. *Pseudopanorpidium inversa* sp. nov. Holotype male GPIH07021. **A, B.** Left and right view of the specimen, respectively. **C.** Drawing of metathoracic leg. **D.** Detail of (torn off) cerci (red asterisks). Abbreviations: mf = metafemur; mt = metatibia; mts = metatibial spurs; mbt = metabasitarsus. Scale bars: 5 mm (**A–C**); 1 mm (**D**).

Diagnosis of species.—The species is easily distinguished from any other Elcanidae by the presence of two dark round spots and a dark margin on the hindwings. The pronotum is posteriorly pointed. Cerci are not setulose but feature a hair-like tip.

Description.—Male. Preserved parts include the posterior tip of the pronotum, the wings, most of the metathoracic leg (only tarsal regions missing), and aspects of the abdomen. Preserved body length 6.25 mm.

Forewing.—Length 14 mm. Base of wing covered by posteriorly pointed pronotum. CuPaβ, CuPb and 1A distally fused. CuPaα fused with CuA + CuPaα. M with four branches (MP, MA2, MA1, MA1). All four branches of M between CuA + CuPaα and the stem of RP. RP with 8 branches. RP1, 3 and 4 with diverging branches toward distal margin. RP2 fused to RP3. Pterostigma dark and sclerotized, showing cross veins.

Hindwing.—Length 13.1 mm. Venation unsure due to overlap with forewing and folding. Conspicuous wing markings consisting of two 1.1 mm wide wing spots—anterior 1.2 mm high and posterior 0.84 mm high—as well as a dark wing band of a maximum width of 2.5 mm. Pterostigma of the hindwing about half the height of forewing pterostigma.

Metathoracic leg.—Metafemur 6.8 mm long. Few dark blotches dispersed over the surface. Proximally with very short hair on dorsal surface. Metatibia 5.3 mm long. Row of nine small denticles proximal to main spurs. Main metatibial spurs in three pairs and of ensiform shape ranging between 1 mm and 0.7 mm in size. Metabasitarsus broken off and lost shortly after its origin. Preserved part of basitarsus setulose and with one triangular spur or lobe close to breaking point.

Abdomen.—Nine tergites visible, each with rather long and numerous hairs on the dorsal surface. Cerci ca. 1.5 mm long, not setulose; bearing a hair-like tip.

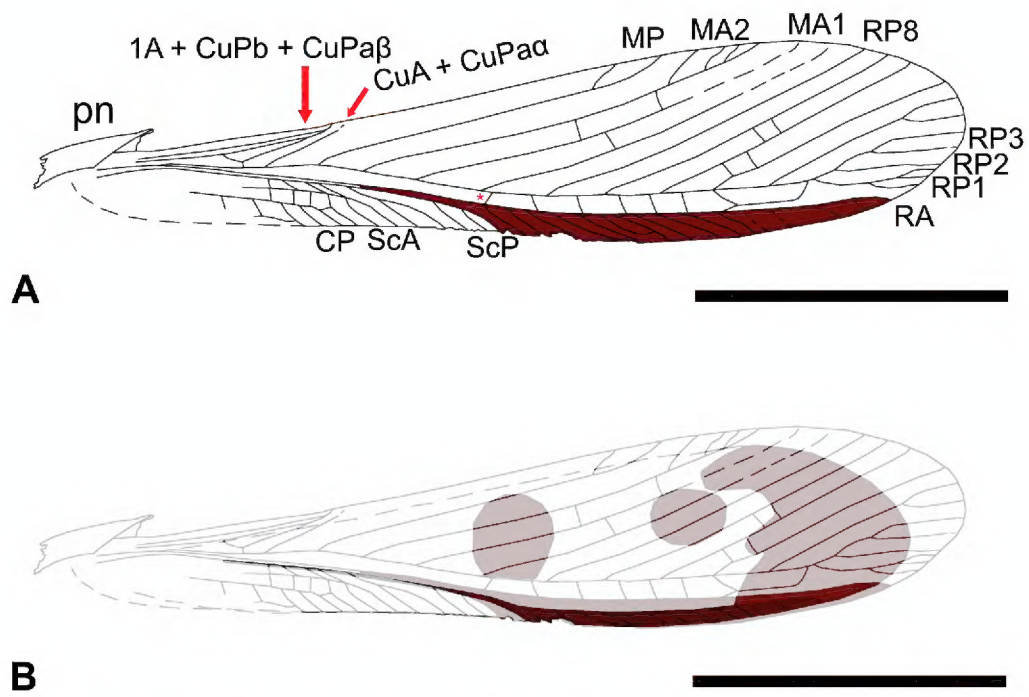

Fig. 2. *Pseudopanorpidium inversa* sp. nov. Holotype male GPIH07021. **A.** Posterior part of pronotum and forewing venation. Red asterisk marking position of RP stem. **B.** Outline and color pattern of hindwing underlying the forewing. The effect was created by overlying two layers (forewing/hindwing) in GIMP and changing the opacity on the top layer (forewing) to 50%. Scale bars: 5 mm.

Remarks.—*Pseudopanorpidium* was erected by Schall, Willmott, Kotthoff & Husemann (2025) in Willmott et al. (2025) to include the Burmese amber specimens very similar to *Panorpidium* Westwood, 1854 that differ from the latter genus by featuring an elongated anterior tegminal margin between CuA + CuPaα and MP. Until now, the genus was monotypical with only *Pseudopanorpidium maculosum* (Zhou, Xu, Jarzembowski & Xiao, 2022). In the new species *P. inversa*, the length of the wing margin between CuA + CuPaα and MP cannot be accurately determined because the termination of CuA + CuPaα is not seen due to slight wing wrapping of the forewing on the dorsal side of the specimen. Still, based on the path of CuA + CuPaα that can be seen, it is probably longer than usual for species of *Panorpidium*, suggesting a placement in *Pseudopanorpidium*. The new species differs from *P. maculosum* by the two wing spots being located on the hindwings instead of forewings as well as the dark wing margin being absent or less broad in *P. maculosum* (the apical portion of the forewing of *P. maculosum* is not preserved, but if the margin was as broad as in *P. inversa*, it ought to be visible in the preserved part). The presence of this color pattern on the hindwings rather than forewings is unusual for Elcanidae, but not necessarily for Orthoptera. For example, the peacock katydid *Pterochroza ocellata* (Linnaeus, 1758) has its most prominent wing spots (used during defensive display) located on the hindwings. Also, many species of Oedipodinae Walker, 1871 have brightly colored hindwings with dark markings.

The type specimen of *P. inversa* has the stem of RP located posterior to the second branch of MA1. This is atypical for this genus as well as for *Panorpidium*, which is usually defined by the stem of RP located between the two branches of MA1. The location of the RP stem was properly introduced as a character of high taxonomic value by Gorochov et al. (2006). However, Zessin (1987) noted on the various specimens of elcanid forewings he had studied from the Jurassic of Germany that "the proximal beginning of RP varies significantly in its position in regard to MA1 (* = MA2 in our modern understanding) within the same species already" (translated from Zessin (1987)). The specimens described by Zessin (1987) do not belong in *Panorpidium*, although they are currently positioned in the genus; instead, they likely belong to a genus of Archelcaninae (Gorochov and Coram 2022, Heads et al. 2022). Nonetheless, if variation of the RP stem occurred in specimens of the same species of Archelcaninae, it is reasonable to assume it could also occur in Elcaninae. In conclusion, we argue that the diagnosis of *Panorpidium* and *Pseudopanorpidium* should include the stem of RP located between branches of MA1 or posterior of second MA1. It should also be considered whether the variation may have been even greater and include a position between MA2 and the anterior MA1. If so, *Probaisselcana* Gorochov, 1989 and *Pseudoprobaisselcana Schall, Willmott, Kotthoff & Husemann, 2025* would need to be considered synonyms of *Panorpidium* and *Pseudopanorpidium*, respectively.

Subfamily Archelcaninae Gorochov, Jarzembowski & Coram, 2006

Thagyaminana gen. nov.

https://zoobank.org/F972C0FB-A868-46E9-ACD3-9EB0F40D7A42

Type species.—*Thagyaminana atawedeia* sp. nov.

Etymology.—The genus name is a contraction of the Buddhist God and King of Heaven Thagyamin and the commonly used ending "elcana" for Elcanidae. With this name, we want to pay respect to the traditional Burmese Buddhist belief and the geographic origin of the specimen.

Diagnosis of genus.—Antennomeres with paired small spines. Posterior part of pronotum broad and rounded. Forewing: margin between CuPaβ and CuA + CuPaα longer than between CuA + CuPaα and MP. CuPaα fused to CuA + CuPaα. Three branches of M between CuA + CuPaα and the stem of RP (*see remarks in section on previous species about the taxonomic value of this character). Pterostigma without cross veins. Two dark spots, anterior larger than posterior. Hindwing: CuPaβ and CuA + CuPaα very long. Margin between CuPb and CuPaβ making up major part of hindwing length. CuPaα fused to MP. M with two branches. Stem of RP between MP and MA2. Metatibial spurs leaf-like. Ovipositor sword-shaped, 7.3 mm long. Cerci not setulose.

Thagyaminana atawedeia **sp. nov.**

https://zoobank.org/A18666F9-8973-4304-889F-773C300A2FA7

Figs 3–5

Etymology.—The species' name derives from the Burmese name of one of the heavens of Buddhist cosmology, tàwədèɪʊ̃ɸà, plus the latin prefix a- (from). As the genus name refers to the ruler of this heaven, Thagyamin, the full species name can be translated as "the ruler of the Heaven from tàwədèɪʊ̃ɸà" and is meant as a homage to the origin of the specimen and Theravada Buddhism.

Locality and horizon.—The specimen was found in amber from two amber mines in Hkamti, Sagaing Division, Myanmar or Tanai, Kachin State Burma, Myanmar. The amber from Hkamti is ca. 110 My and the amber from Tanai is ca. 99 My old.

Holotype.—Female holotype specimen part of LIB, Hamburg, collection number GPIH07022.

Diagnosis of species.—As for genus (monotypic).

Description.—Female. Very good state of preservation. Body length of the specimen ca. 7.8 mm (measured from tip of head to base of ovipositor).

Forewing.—Length of forewing 13.5 mm. 1A, CuPb and CuPaβ free. M has four branches. Anterior three branches of M between CuA + CuPaα and the stem of RP. Margin between CuPaβ and CuA + CuPaα makes up 18.1% of total wing length. Margin between CuA + CuPaα and MP makes up 15.6% of total wing length. RP with 10 branches. ScP with numerous cross veins. ScA with few cross veins (3–4). CP with still less cross veins (1). Pterostigma dark and sclerotized, without cross veins. Two darkly colored wing spots present in central wing area. The anterior spot larger than posterior (1.6 mm vs. 1.16 mm high). No colored margin.

Hindwing.—Length 12.7 mm. 1A and CuPb unsure. Margin between CuPb and CuPaβ very long and with numerous regular cross veins. CuA + CuPaα cuts off CuPaα at the start. CuPaβ and CuA + CuPaα very long (almost and reaching distal wing margin, respectively). M with two branches. Stem of RP between MP and MA2. RP with six branches. Terminal RP1 and RA with distinct net pattern. Pterostigma of the hindwing also without cross veins, slightly less high than in the forewing. No wing spots are present on the hindwing.

Antennae and eyes.—Preserved part of longer antenna approximately 13.5 mm long. Antennal segments of uniform thickness and shape throughout antennal length. Presence of likely two (although often only one is preserved) small spines on either side at the distal end of each antennal segment. Eyes almost circular in profile, 0.73 mm high and 0.68 mm wide.

Pronotum.—Length 3.2 mm, covering wing base. Lateral margin of pronotum saddle shaped. Posterior part broad and rounded. Anterior part of pronotum dorsally with light, posterior part with dark coloration.

Legs.—Prothoracic leg not well visible. Mesothoracic femur of approximately similar length and diameter as mesotibia. Only parts of tibiae of metathoracic legs visible. Metatibial spurs leaf-like. At least two apical spurs present, one smaller and one larger (in both width and length).

Abdomen.—Ovipositor visible in ventral view. Sword-shaped, 7.3 mm long. Cerci unsegmented, not setulose and without appendage, 2.2 mm long.

Remarks.—The new species is placed in the subfamily Archelcaninae based on its forewing venation feature of 1A, CuPb, and CuPaβ not being fused. It can be readily separated from the Archelcaninae

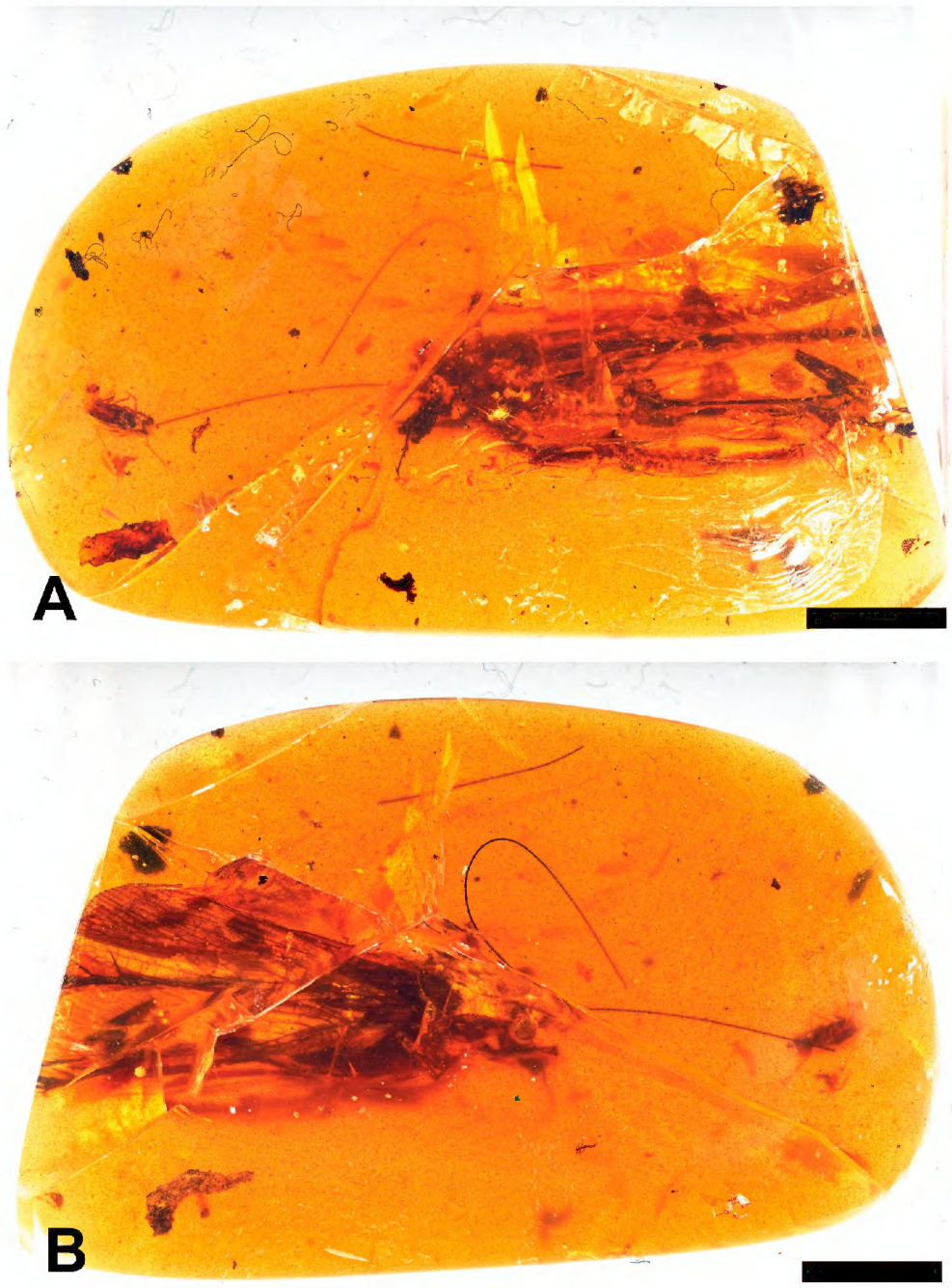

Fig. 3. *Thagyaminana atawedeia* gen. et sp. nov. Holotype female GPIH07022. **A, B.** Left and right view of the specimen, respectively. Scale bars: 5 mm.

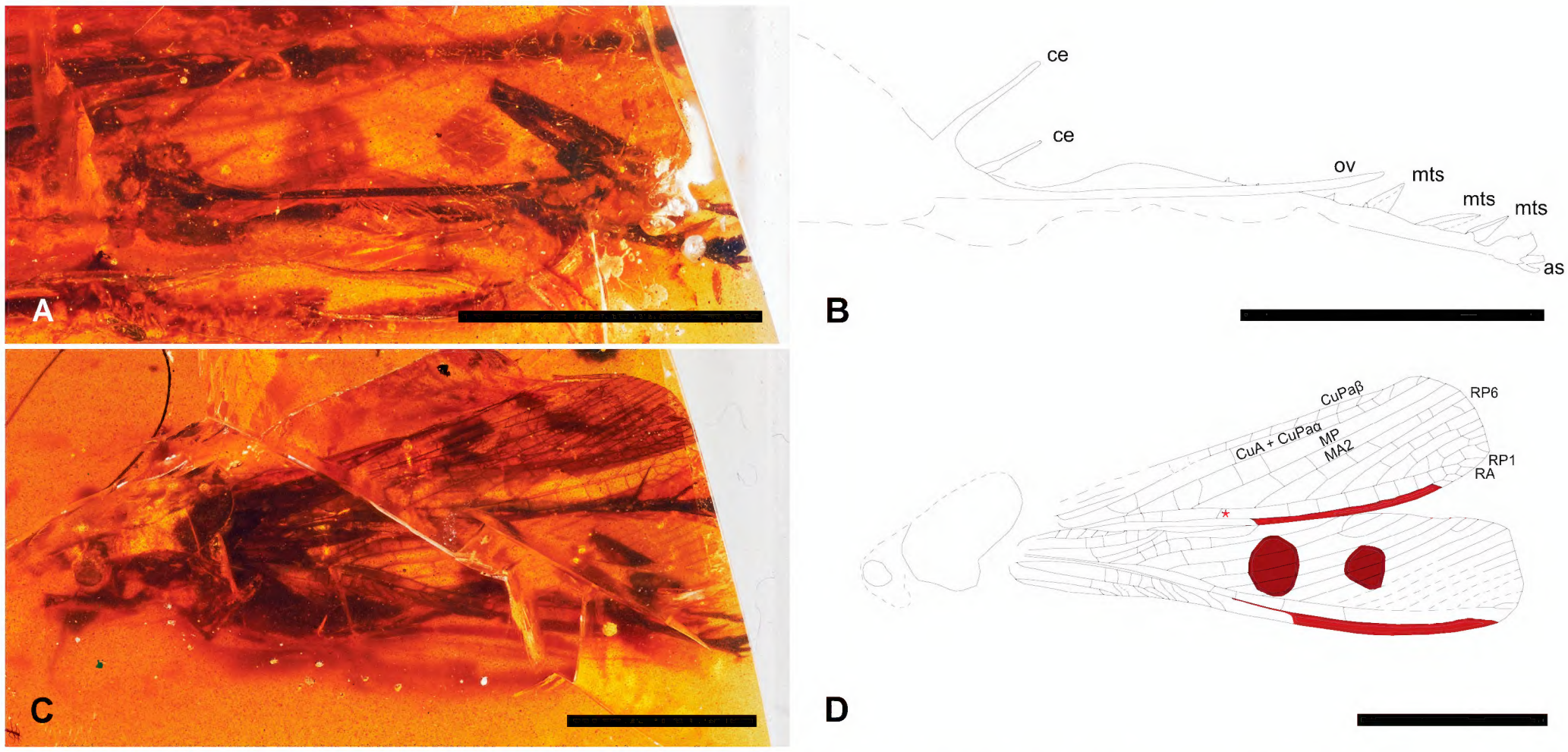

Fig. 4. *Thagyaminana atawedeia* gen. et sp. nov. Holotype female GPIH07022. **A, B.** Detail of abdomen and hindleg and drawing of the same. **C, D.** Detail of head, pronotum, and wings and drawing of the same (some parts, such as legs and antenna, are not shown in the drawing). Red asterisk marks stem of RP in the hindwing. Abbreviations: ce, cercus; ov, ovipositor; mts, metatibial spurs; as, apical spurs. Scale bars: 5 mm.

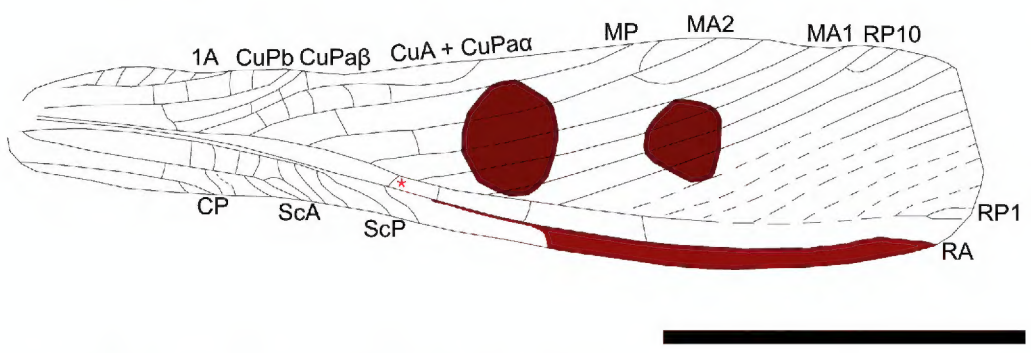

Fig. 5. *Thagyaminana atawedeia* gen. et sp. nov. Holotype female GPIH07022. Drawing of the forewing. Red asterisk marks stem of RP. Scale bar: 5 mm.

genera *Archelcana* Sharov, 1968, *Sibelcana* Gorochov, 1990, *Sinoelcana* Gu, Tian, Wang & Yue, 2020, and *Synelcana* Zessin, 1988 by exhibiting the more derived color pattern seen in many Cretaceous elcanids (two dark round wing spots) as opposed to the cryptic color pattern of the Jurassic species present in the aforementioned genera. In *Parelcana* Handlirsch, 1906 CuPaα is fused to MP, but in *T. atawedeia*, CuPaα is fused to CuA + CuPaα. *Caelielca spinocrus* Uchida, 2022 and *Jeholelcana yanensis* Fang, Heads, Wang, Zhang & Wang, 2018 differ from *Thagyaminana atawedeia* by not showing two dark wing spots on their tegmina. *Hukawnelca gracile* Uchida, 2022 can be separated from *T. atawedeia* by its setulose cerci, the cross veins in the area of the pterostigma as well as the small pointed extension at the dorsal end of its pronotum. Differences between the new species and the three species of *Hispanelcana* Peñalver & Grimaldi, 2010 are as follows: for *H. arilloi* Peñalver & Grimaldi, 2010 and *H. lopezvallei* Peñalver & Grimaldi, 2010, *T. atawedeia* differs by the heavily setulose cerci of the Spanish Elcanidae (without setae in *T. atawedeia*); *Hispanelcana alavensis* Peñalver & Grimaldi, 2010 differs from *T. atawedeia* in the type of metatibial spurs, which are paddle-like in the former and leaf-like in the latter.

Acknowledgements

The authors thank Dr. Klaus-Gerhard Heller (Friedrich-Alexander-University Erlangen), Dr. Jun-Jie Gu (Sichuan Agricultural University) and Dr. Olivier Béthoux (Muséum National d'Histoire Naturelle) for their very helpful comments on an earlier draft of this study. We also thank Dr. Tony Robillard (Muséum National d'Histoire Naturelle) and Nancy Morris for additional comments helping to improve the present article. Additionally, we wish to thank Eileen Nguyen from the LIB Hamburg, section Lepidoptera, for her technical support of this study.

References

Béthoux O, Nel A (2002) Venation pattern and revision of Orthoptera sensu nov. and sister groups. Phylogeny of Palaeozoic and Mesozoic Orthoptera sensu nov. Zootaxa 96: 1–88. https://doi.org/10.11646/zootaxa.96.1.1

Bolotov IN, Pasupuleti R, Subba Rao NV, Unnikrishnan SK, Chan N, Lunn Z, Win T, Gofarov MY, Kondakov AV, Konopleva ES, Lyubas AA, Tomilova AA, Vikhrev IV, Pfenninger M, Düwel SS, Feldmeyer B, Nesemann HF, Nagel KO (2022) Oriental freshwater mussels arose in East Gondwana and arrived to Asia on the Indian Plate and Burma Terrane. Scientific Reports 12: 1–26. https://doi.org/10.1038/s41598-022-05257-0

Cigliano MM, Braun H, Eades DC, Otte D (2024) Orthoptera Species File [03.2024]. http://orthoptera.speciesfile.org/

Dunne EM, Raja NB, Stewens PP, Zaw K (2022) Ethics, law, and politics in palaeontological research: The case of Myanmar amber. Communications Biology 5: 1023. https://doi.org/10.1038/s42003-022-03847-2

Fang Y, Muscente AD, Heads SW, Wang B, Xiao S (2018) The earliest Elcanidae (Insecta, Orthoptera) from the Upper Triassic of North America. Journal of Paleontology 92: 1028–1034. https://doi.org/10.1017/jpa.2018.20

The GIMP Team (2024) GIMP v. 2.10.30. https://www.gimp.org/

Gorochov AV (1989) New taxa of the orthopteran families Bintoniellidae, Xenopteridae, Permelcanidae and Vitimiidae [Vitimidae] (Orthoptera, Ensifera) from Mesozoic Asia. Vestnik Zoologii 4: 20–27.

Gorochov AV (1990) Orthopterans. Gryllida. Late Mesozoic insects from Eastern Transbaicalia. Trudy Zoologitscheskogo Instituta, Akademiia Nauk SSSR, Leningrad [= Proceedings of the Zoological Institute, USSR Academy of Sciences, Leningrad] 239: 210–214.

Gorochov AV, Jarzembowski EA, Coram RA (2006) Grasshoppers and crickets (Insecta: Orthoptera) from the Lower Cretaceous of southern England. Cretaceous Research 27: 641–662. https://doi.org/10.1016/j.cretres.2006.03.007

Gorochov AV, Coram RA (2022) New and little known taxa of the suborder Ensifera (Insecta: Orthoptera) from the Lower Cretaceous of England. Cretaceous Research 134: 105164. https://doi.org/10.1016/j.cretres.2022.105164

Gu JJ, Tian H, Wang J, Zhang W, Ren D, Yue Y (2020) A world key to the genera of Elcanidae (Insecta, Orthoptera), with a Jurassic new genus and species of Archelcaninae from China. ZooKeys 954: 65–74. https://doi.org/10.3897/zookeys.954.52088

Handlirsch A (1906) Die fossilen Insekten und die Phylogenie der rezenten Formen: ein Handbuch für Paläontologen und Zoologen. [No Title]

Heads SW, Thomas MJ, Wang Y (2018) A new genus and species of Elcanidae (Insecta: Orthoptera) from Cretaceous Burmese amber. Zootaxa 4527: 575–580. https://doi.org/10.11646/zootaxa.4527.4.8

Heads S, Thuy B, Tamarri J (2022) Two new species of *Archelcana* Sharov (Orthoptera: Elcanidae) from the Lower Jurassic of Luxembourg. Kentiana 1: 1–13. https://doi.org/10.21900/j.kentiana.n1.1121

Hu TH, He ZQ (2023) A new species of genus *Probaisselcana* (Orthoptera: Elcanidae) from mid-Cretaceous Burmese amber. Cretaceous Research 151: 105671. https://doi.org/10.1016/j.cretres.2023.105671

The Inkscape Team (2025) Inkscape v. 1.4. https://inkscape.org/de/

Kočárek P (2020) A diminutive elcanid from mid-Cretaceous Burmese amber, *Ellca nevelka* gen. et sp. nov., and the function of metatibial spurs in Elcanidae (Orthoptera). Cretaceous Research 116: 104574. https://doi.org/10.1016/j.cretres.2020.104574

Linnaeus C (1758) In Systema Naturae per Regna tria naturae (10th edn.). Holmiae. Vol. 1, 824 pp.

Nel A, Jouault C (2022) New grasshoppers (Orthoptera: Elcanidae, Locustopsidae) from the Lower Cretaceous Crato formation suggest a biome homogeneity in Central Gondwana. Historical Biology 34: 2070–2078. https://doi.org/10.1080/08912963.2021.2000602

Olivier AG (1789) Encyclopedie methodique, dictionnaire des insectes, Vol. 4. Paris: Pankouke, 373, 331.

Peñalver E, Grimaldi DA (2010) Latest occurrences of the Mesozoic family Elcanidae (Insecta: Orthoptera), in Cretaceous amber from Myanmar and Spain. Annales de la Société entomologique de France 46: 88–99. https://doi.org/10.1080/00379271.2010.10697641

Peretti A (2020) Ethical guidelines for Burmese amber acquisitions. Journal of Applied Ethical Mining of Natural Resources and Paleontology 1: 4–78. https://www.pmf.org/journal

Peretti A (2021) An alternative perspective for acquisitions of amber from Myanmar including recommendations of the United Nations Human Rights Council. Journal of International Humanitarian Action 6: 12. https://doi.org/10.1186/s41018-021-00101-y

Poinar G, Gorochov AV, Buckley R (2007) *Longioculus burmensis*, n. gen., n. sp. (Orthoptera: Elcanidae) in Burmese amber. Proceedings, Entomological Society of Washington 109: 649.

Sharov AG (1968) Filogniya orthopteroidnykh nasekomykh [1971 English translation: Phylogeny of the Orthopteroidea]. Trudy Paleontologicheskogo Instituta, Akademiia Nauk SSSR [= Transactions of the Institute of Paleontology, USSR Academy of Sciences] 118: 1–216.

Schubnel T, Desutter-Grandcolas L, Garrouste R, Hervet S, Nel A (2020) Paleocene of Menat Formation, France, reveals an extraordinary diversity of orthopterans and the last known survivor of a Mesozoic Elcanidae. Acta Palaeontologica Polonica 65: 371–385. https://doi.org/10.4202/app.00676.2019

Shi G, Grimaldi DA, Harlow GE, Wang J, Wang J, Yang M, Lei W, Li Q, Li X (2012) Age constraint on Burmese amber based on U–Pb dating of zircons. Cretaceous Research 37: 155–163. https://doi.org/10.1016/j.cretres.2012.03.014

Tillyard RJ (1918) A fossil insect wing from the roof of the coal-seam in the Sydney harbour colliery. Proceedings of the Linnean Society of New South Wales 43: 260–264.

Uchida K (2022) Two new genera of the Elcanidae (order: Orthoptera) from middle Cretaceous Burmese amber of northern Myanmar. Cretaceous Research 131: 105092. https://doi.org/10.1016/j.cretres.2021.105092

Walker F (1871) Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum: Vol. Supplement. London, 1–116.

Westerweel J, Roperch P, Licht A, Dupont-Nivet G, Win Z, Poblete F, Ruffet G, Swe HH, Thi MK, Aung DW (2019) Burma Terrane part of the Trans-Tethyan arc during collision with India according to palaeomagnetic data. Nature Geoscience 12: 863–868. https://doi.org/10.1038/s41561-019-0443-2

Westwood JO (1854) Contributions to fossil entomology. The Quarterly Journal of the Geological Society of London 10: 378–396. [pls 46–48] https://doi.org/10.1144/GSL.JGS.1854.010.01-02.43

Willmott LA, Schall OKO, Kotthoff U, Husemann M (2025) New species of Burmese amber Elcanidae (Insecta: Orthoptera) suggest Gondwanan origin and demonstrate ovipositor diversity. PalZ 99(1): 35–51. https://doi.org/10.1007/s12542-025-00717-0

Xing L, Qiu L (2020) Zircon UPb age constraints on the mid-Cretaceous Hkamti amber biota in northern Myanmar. Palaeogeography, Palaeoclimatology, Palaeoecology 558: 109960. https://doi.org/10.1016/j.palaeo.2020.109960

Zessin W (1987) Variabilität, Merkmalswandel und Phylogenie der Elcanidae im Jungpaläozoikum und Mesozoikum und die Phylogenie der Ensifera (Orthopteroida, Ensifera). Deutsche Entomologische Zeitschrift 34: 1–76. https://doi.org/10.1002/mmnd.19870340102

Zessin W (1988) Neue Saltatoria (Insecta) aus dem Oberlias Mitteleuropas. Freiberger Forschungshefte Reihe C 419: 107–121.

Zhou Q, Xu C, Jarzembowski E A, Xiao C (2022) A new species of Elcanidae (Insecta: Orthoptera) from mid-Cretaceous Kachin amber. Cretaceous Research 136: 105226. https://doi.org/10.1016/j.cretres.2022.105226

Zhou Y, Xu C, Fang Y, Xiao C, Beutel RG (2024) A new species of genus *Probaisselcana* (Orthoptera: Elcanidae) from mid-Cretaceous Kachin amber of northern Myanmar. Palaeontographica Abteilung A: Paläozoologie 329: 19–32. https://doi.org/10.1127/pala/2024/0156